March 2, 1965 A. I. LIVAS 3,171,377

DRAFT REDUCING DEVICE FOR VESSELS

Filed May 20, 1963

2 Sheets-Sheet 1

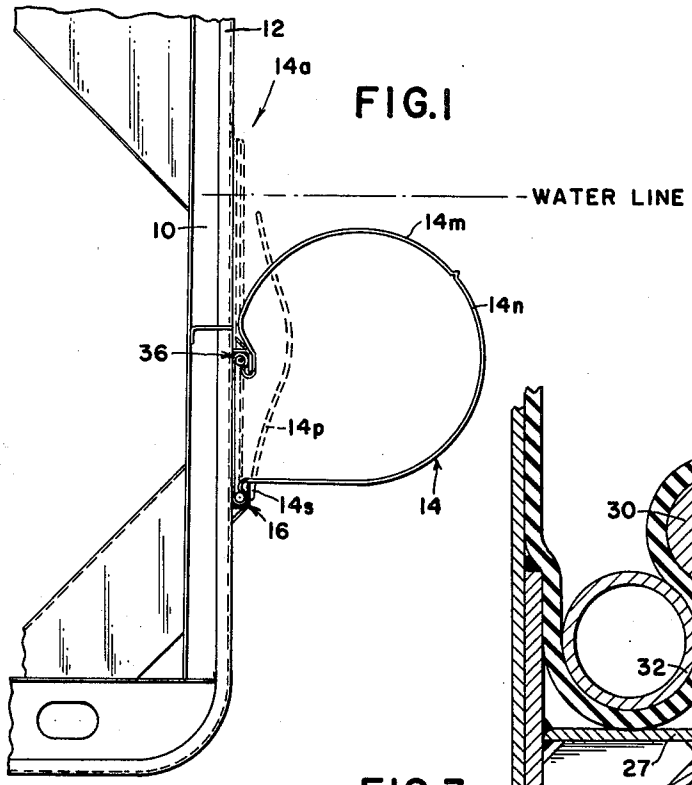


FIG. 1

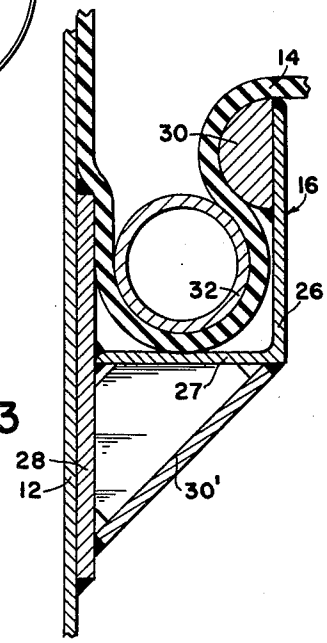
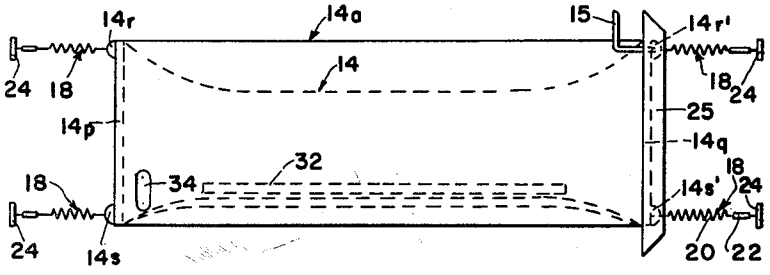


FIG. 3

FIG. 2



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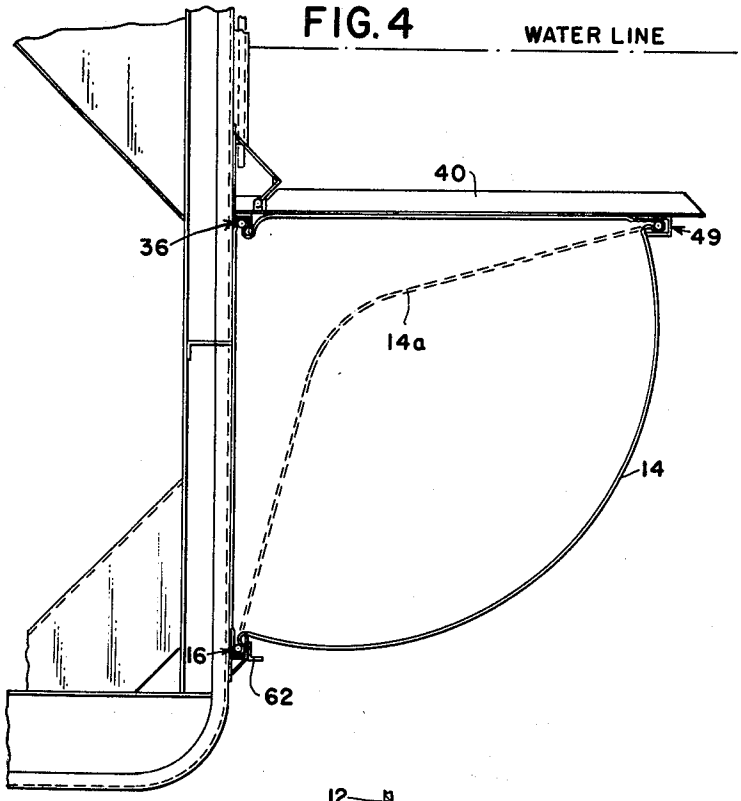
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FIG. 4



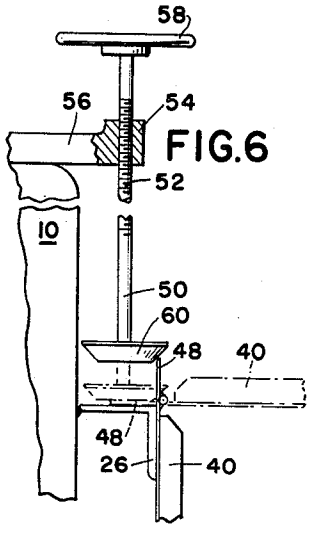


FIG. 6

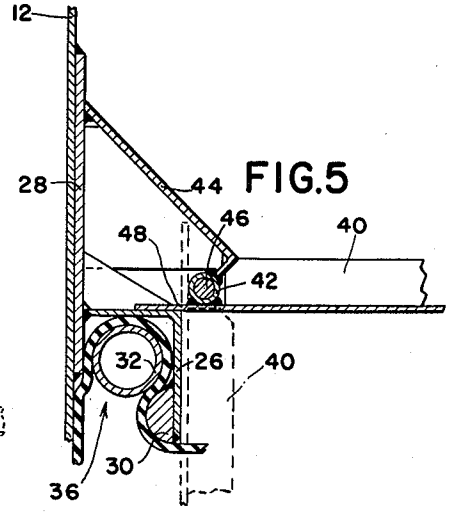


FIG. 5

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DRAFT REDUCING DEVICE FOR VESSELS

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6 Claims. (Cl. 114—49)

This invention relates to method and apparatus for reducing the draft of vessels when they are leaving or entering a harbor having insufficient water depth for accommodating such sea-going vessels.

In particular, this invention is directed to adapting a sea-going vessel of standard design with a draft reducing device as distinguished from modifying or reconstructing the ship's hull (or designing a special hull for a new special purpose ship) when the problem at hand is to load and transport a ship for an economical sea-going voyage to the extend where it cannot enter a specific harbor having insufficient water depth.

Up to the present time, it has been the practice to meet such problem by: (*a*) building a new ship of special hull design, or (*b*) extensively modifying a general purpose ship, or (*c*) reducing the cargo loaded at the beginning of the sea-going voyage, or (*d*) unloading a portion of a fully loaded ship after the sea-going voyage and before entering the harbor until the draft has been sufficiently reduced to permit the ship to enter. The same solutions have also been applied to ships loaded with cargo for sea-going voyage which must cross shallow water within a harbor before reaching the high seas.

In its broadest aspect, and in accordance with apparatus of the present invention, there is provided a draft reducing adaptor for vessels which comprises a flexible inflatable container adapted for receiving air under pressure, attachment means securable to said container and adapted to be fastened to the side of a vessel so that at least a portion of the container is below the water line, and means automatically folding the flexible container flatly against the side of the vessel when air is removed from the inflated container.

In accordance with the invention there is also provided a method of reducing the draft of a ship at the end of a sea voyage and before entering a harbor which comprises applying oppositely directed tension forces from the ends of air tight elongated flexible inflatable container towards the ship's side during the sea voyage while the container is deflated, connecting the container to the ship's side at least along one longitudinal line element of the container below the water line and inflating the container before entering the harbor.

Further, in accordance with the invention there is provided a method of folding an inflated flexible container flatly along the sides of a vessel which comprises connecting the container to the ship's side along an upper and lower longitudinal line element of the container, moving a third longitudinal line element of the container exterior of the said upper and lower line elements downwardly along an arc while the container is being deflated and applying water forces to said deflating container to fold the deflating container in half up against the ship's side.

The prior art for at least the last one hundred years is replete with devices for temporarily increasing the ship's displacement by various pontoon arrangements and it is significant to note that in spite of tremendous efforts expended by commercial interest to solve the very real and commonly prevailing problem, there nevertheless has not evolved, prior to the present invention, a device which has received any practical commercial acceptance. This invention is specifically directed to the long-needed practical solution to the long outstanding problem. For instance, according to this invention, there is no need to

construct cavities into the side of the vessel either below or above the water line so that the present inventive draft reducing adaptor can be fitted with relatively little expense to the sides of existing ships with side and hull contours designed for economical speeds and general sea-going duties. As a practical commercial consideration, the draft reducing adaptor of the present invention can be carried upon the ship's sides during an ocean-going voyage without materially affecting the ship's speed in a troubleless manner so that it is immediately available for its intended purpose to reduce the ship's draft by merely hand turning of valves or stems after the sea-going voyage is completed and the ship is about to enter the harbor.

Other objects and features of the present invention will be set forth or apparent in the following description and claims and illustrated in the accompanying drawings, which disclose by way of example, and not by way of limitation, in a limited number of embodiments, the principle of the invention and structural and method implementations of the inventive concept.

In the drawings, in which like reference numbers designate like components in the several views:

FIG. 1 is a vertical sectional view of one embodiment of a draft reducing adaptor for ships according to the invention;

FIG. 2 is a plan view of FIG. 1;

FIG. 3 is a vertical sectional view of the container attachment device of FIG. 1;

FIG. 4 is a vertical section of another embodiment of a draft reducing adaptor for ships according to the invention;

FIG. 5 is a vertical sectional view of the cover hinge arrangement and upper container attachment device according to FIG. 4; and

FIG. 6 is a vertical sectional view of a combination positively closing and locking device for the cover member of FIG. 4 in its closed and open positions according to the invention.

In FIG. 1, a ship **10** having a generally vertical side **12** is fitted with a draft reducing adaptor comprising an inflatable flexible air tight container **14** having at least one attachment device **16**. The attachment device **16** is welded or otherwise fastened to the ship's side **12** at a location so that a major portion of flexible container **14** when inflated through fitting **15** will be below the water line so as to provide a maximum positive lifting force upon the loaded ship.

In one embodiment of the invention, the flexible container **14** is fabricated from two rectangular panels **14***m* and **14***n* which are sealed together at their peripheries, each panel having a nylon cord or fabric, reinforced rubber wall. Such containers are manufactured for liquid container purposes by the United States Rubber Corp., U.S.A., under the trade name "Sealedtank" and by Dracone Operations Limited, England, under the trade name "Dracons." As shown in FIGS. 1 and 2, the flexible container **14** has the two panels **14***m* and **14***n*, secured together in a manner to form two parallel linear end seams **14***p*, **14***q*, each with two securing tabs **14***r*, **14***s*, **14***r'*, **14***s'*. Four stressing means **18** are arranged to tension stress the tabs **14***r*, **14***r'*, **14***s*, **14***s'*. All of the stressing means **18** may be of similar construction, each incorporating a spring **20** and a turnbuckle **22** between a pad-eye **24** and one of the container tabs. Alternatively, the stressing means **18** may be lines or ropes connected to a winch for stowing the deflated container snugly against the ship's side **12**.

The shape of the flexible inflated container and the stressing means **18**, are designed so that the container, when deflated, will be urged flatly against the ship's side **12** as shown in dotted outline **14***a* on FIG. 1 and in

full outline **14***a* on FIG. 2. The inflated shape of the flexible container is shown in full outline **14** on FIG. 1 and in dotted **14** on FIG. 2. When the deflated container **14***a* is urged and held in a flat position it will not materially interfere with the ship's speed during its sea-going voyage. To this end, it may be preferable to weld a faring member **25** at the forward and of the container so as to further prevent any tendency of the water to vibrate the deflated container **14***a* against the ship's side **12**.

The flexible container **14**, when inflated, applies its buoyancy force to the ship by the attachment device **16** which is welded to the ship's side **12** at a location so that the major portion of the inflated container **14** will be below the water line. Clearly, all of the tremendous force required to reduce the ship's draft must be transferred from the inflated flexible container envelope **14** to the attachment device **16** in a manner to avoid tearing of the container envelope, such problem being further aggravated by the forward movement of the ship when the container is inflated.

One embodiment of the attachment device **16** is shown in FIGS. 1 and 3. The attachment device **16** comprises an angle **26** welded to a backing plate **28** with a reinforcing strut **30'**. The backing plate **28** is welded to the ship's side **12**. A half-round member **30** is welded to the inside upstanding end of the angle **26**. According to the invention, a pipe member **32** having a greater diameter than the minimum spacing between **30** and **28** or **12** and a somewhat shorter length than the length of the deflated flexible container **14** is employed to effect the securing of the container **14** to the ship's side. Container **14** has a sealable air tight hand hole **34** in the lower end portion thereof which permits the manipulation of the flexible container **14** to assume a position in the interior of angle **26** below the half-round **30** as shown in FIG. 3. Thereafter, pipe **32** is slid into position through hand hold **34** to complete the attachment operation (see FIG. 2). It is clear that while the container wall **14** can adjust its position within the attachment member **26** so as to relieve any concentrated stresses on the container wall, the container wall **14** cannot pull out of the attachment device **26** by virtue of the half-round **30** preventing pipe **32** from moving out of angle **26**. Preferably, a second attachment device **36**, identical with attachment device **16** but with angle **26** in an inverted position, is employed to assist the securing of the container **14** to the ship's side **12**. Thereby the lifting force upon the ship is distributed upon two spaced locations and the inflated container is held closer against the ship.

Another embodiment of the invention is shown in FIGS. 4 and 5 wherein there is provided a cover member **40** to protect the deflated flexible container **14** from injury both during a sea voyage and while the ship is approaching or is tied up at its dock after negotiating the harbor waters. Cover member **40** has a length preferably at least equal to the length of the deflated container **14***a* and it may be sectionalized into conveniently fabricatable lengths.

Cover member **40** is hinged near the upper attachment device **36**. A hinge **42** is welded to a bracket **44**, the latter being welded to backing plate **28** and the ship's side **12**. A hinge pin **46** cooperating with hinge **42** carries cover member **40**. Member **40** has an inboard overhanging portion **48** which comes in contact with and rests upon the horizontal back portion of angle **26** of attachment device **36** when the cover member **40** is in its horizontal open position. Such horizontal open position for cover member **40** is the normal position when the container **14** is inflated as shown in FIG. 4. Accordingly, the buoyancy force upon the container **14** is transferred to the ship **10** not only at the attachment devices **16**, **36** but also along bracket **44** and angle **26** when the buoyancy force of container **14** is distributed along the width of cover member **40**.

In FIG. 4, another attachment device **49** attaches a third region of container **14** to an outboard region of cover member **40**, attachment device **49** being similar to the attachment devices **16** and **36**. With such an arrangement, as the container **14** is being deflated (either by opening a valve to atmosphere or by pumping the air out of the container) the container wall will be forced by water pressure into the dashed line position **14***a* in FIG. 4 since the cover member **40** is below the water line. It is very important to observe that this feature of the invention employs the action of the water forces to neatly and properly fold the deflated container wall into the pocket provided by the cover member.

It is to be understood that the tension stressing devices **18** may also be used, if necessary, in the embodiment according to FIG. 4.

According to the invention as shown in FIGS. 4 and 5, the force of the water pressure against the flexible container **14** as it is being deflated prevents the container wall from sagging below the level of lower attachment device **16** so that when cover member **40** is finally closed against the ship's side **12**, the entire deflated container **14***a* will be automatically folded in half into the pocket between cover member **40** and the ship's side **12**. In addition to the action of the water forces on the deflating container, the cover member **40** will move by gravity towards the ship's side **12**. After it reaches a near vertical position, a positive cover closing device as shown in FIG. 6 completes the closure of cover member **40** and additionally locks it in its final position. In FIG. 6, a threaded stem **50** is movable vertically by a thread **52** thereon which cooperates with a threaded nut **54** welded to a bracket **56**, the bracket **56** being welded to a convenient location on the ship **10**. Rotating the stem **50** as by a hand wheel **58** lowers a thick beveled edged disk **60** which is carried by stem **50**. As shown in FIG. 6, the edge of the near vertical overhanging end **48** of cover member plate **42** is engaged by the sloping face of member **62**. Thereafter, as hand wheel **58** is turned to move member **60** downwardly, cover member **42** is positively urged into its final closing position, that is, until the outboard end of **42** rests up against stop **62** welded to angle **26**.

The mechanism shown in FIG. 6 has a second useful purpose to prevent see-sawing movements of cover plate **40** under wave action when the container **14** is inflated. As shown in dashed outline, cover member **40** can have a horizontal position when member **60** is upwardly retracted and **40** can thereafter be positively locked in such horizontal position by turning down the hand wheel **58** until the underside of member **60** presses the overhanging end **48** of cover member **40** against the topside of angle **26**.

As in FIG. 1, a faring member similar to member **25** can be welded to the ship's side **12** to advantageously channel the water when the ship is moving around the pocket between the closed cover member **40** and the ship's side **12**.

While there has been described and pointed out the fundamental novel features of the invention as applied to preferred embodiments, it will be understood that various omissions and substitutions and changes in the form and details of the devices illustrated and its operation may be made by those skilled in the art, without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

I claim:

1. Draft reducing adaptor for vessels which comprises a flexible inflatable container adapted for receiving air under pressure, attachment means securable to said container and adapted to be fastened to a side of a vessel so that at least a portion of the container is below the water line, and means automatically folding the flexible container flatly against the side of the vessel when air is removed from the inflated container and wherein said attachment means includes a U-shaped member secured to the

ship's side below the water line, a half-round member secured within said U-shaped member near the opening of the latter, and a cylindrical member having a diameter greater than the minimum space between the half-round member and the U-shaped member, said flexible container being positioned between said U-shaped member and said cylindrical member.

2. Draft reducing adaptor for vessels which comprises an elongated flexible inflatable container having substantially parallel end seams, upper and lower attachment means securable to upper and lower portions of said container and adapted to be fastened to a side of the vessel in a manner so that at least a portion of the container is below the water line and means tension stressing at least a portion of said end seams towards the ship's side, the flexible container being shaped so that it will be pressed flatly when deflated against the side of the vessel by the action of said stressing means, said inflatable container being adapted to be inflated and wherein each of said attachment means includes a U-shaped member secured to the ship's side, a half-round member secured to said U-shaped member near the opening of the latter, and a cylindrical member having a diameter greater than the minimum space between the half-round member and the U-shaped member, said flexible container being positioned between said U-shaped member and said cylindrical member.

3. Draft reducing adaptor for vessels which comprises a flexible inflatable container having upper and lower attachment means secured to the upper and lower portions of said container and adapted to be fastened to the side of a sea-going ship so that at least a portion of the container is below the water line, a cover member hinged near said upper attachment means and another attachment means secured to an outboard portion of said cover member and to a portion of said flexible container exterior of the portion between said upper and lower attachment means and wherein each of said attachment means includes a U-shaped member secured to the ship's side, a half-round member secured to said U-shaped member near the opening of the latter, and a cylindrical member having a diameter greater than the minimum space between the half-round member and the U-shaped member, said flexible container being positioned between said U-shaped member and said cylindrical member.

4. Draft reducing adaptor for vessels which comprises a flexible inflatable container having upper and lower attachment means secured to the upper and lower portions of said container and adapted to be fastened to the side of a sea-going ship so that at least a portion of the container is below the water line, a cover member hinged near said upper attachment means, means positively moving and locking said cover member in its final position snugly near said ship's side and another attachment means secured to an outboard portion of said cover member and to a portion of said flexible container exterior of the portion between said upper and lower attachment means and wherein said last mentioned means includes a threaded nut member secured to said ship, a threaded stem member cooperating with said nut member, a bevelled edged disk carried by said threaded stem, the bevelled edge of said disk being engageable with an edge of said cover member when the latter is near vertical so that the cover member is rotated into its final position by a sliding plane motion between the edge of said cover member and said bevelled face.

5. Draft reducing adaptor according to claim 4 wherein said cover member has an overhanging portion relative to its point of being hinged, and there is provided a stop member secured to said ship which engages said overhanging portion and prevents the cover member from swinging above substantially a horizontal position, the end face of said bevelled disk being engageable when said threaded stem is turned with said overhanging portion to lock the latter against the stop member.

6. Draft reducing adaptor for vessels which comprises a flexible inflatable container adapted for receiving air under pressure, attachment means securable to said container and adapted to be fastened to a side of a vessel so that at least a portion of the container is below the water line, and means automatically folding the flexible container flatly against the side of the vessel when air is removed from the inflated container and wherein said automatic folding means includes at least one pair of springs, one end of each being secured to end portions of said container and the other ends of such springs being secured to said ship's side at points to selectively tension said springs.

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